What is claimed is:

1. A method for functionalizing carbon nanotubes comprising:

   a) selecting a plurality of carbon nanotubes; and

   b) reacting said plurality of carbon nanotubes with an organic functionalizing agent in the absence of a solvent.

2. The method of Claim 1, wherein the organic functionalizing agent is selected from the group consisting of diazonium species, aryl radicals, alkyl radicals, aryl carbocations, aryl carbanions, alkyl carbanions, alkyl carbocations, 1,3-dipoles, carbenes, heteroatom-containing radicals, heteroatom-containing cations, heteroatom-containing anions, ylides, benzyne, dienes, dienophiles, organozincates, carbenes, Grignard reagents, Gillman reagents, organolithium reagents, and combinations thereof.

3. The method of Claim 1, wherein the carbon nanotubes are functionalized between about 1 functional group per 1000 carbon atoms of the carbon nanotubes and about 1 functional group per 5 carbon atoms of the carbon nanotubes.

4. The method of Claim 1, wherein the carbon nanotubes are selected from the group consisting of single-wall carbon nanotubes, multi-wall carbon nanotubes, and combinations thereof.

5. The method of Claim 1, wherein the carbon nanotubes are single-wall carbon nanotubes.

6. The method of Claim 1, wherein the carbon nanotubes range in diameter between about 0.7 nm and about 2.0 nm.

7. The method of Claims 1-5 or 6, wherein the step of reacting occurs at a temperature between about 22°C and about 100°C.

8. The method of Claims 1-6 or 7, wherein the step of reacting occurs for a duration between about 1 minute and about 4 hours.

9. The method of Claims 1-7 or 8, wherein the step of reacting is performed under an inert atmosphere.

10. The method of Claims 1-8 or 9, wherein the step of reacting further comprises adding a polymer to effect an *in situ* blending.

11. The method of Claims 1-9 or 10, wherein the step of reacting further comprises mixing the plurality of carbon nanotubes and the organic functionalizing agent.

12. The method of Claim 11, wherein the mixing comprises a mechanical operation.

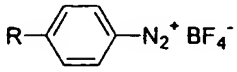
13. The method of Claims 11 or 12, wherein the mixing operation is selected from the group consisting of ball milling, stirring, shaking, high shear mixing, twin-screw mixing, and combinations thereof.

14. The method of Claims 1-12 or 13, wherein the organic functionalizing agent is a reactive diazonium species.

15. The method of Claim 14, wherein the reactive diazonium species is generated from an aryl diazonium salt.

16. The method of Claim 15, wherein the aryl diazonium salt is selected from the group consisting of ortho-substituted aryl diazonium salts, meta-substituted aryl diazonium salts, para-substituted aryl diazonium salts, and combinations thereof.

17. The method of Claim 15 or 16, wherein the diazonium salt comprises:



and wherein R is selected from the group consisting of halogen, nitro, cyano, alkyl, aryl, arylalkyl, hydroxy, carboxylic ester, carboxylic acid, thiocarbonate, amide, alkoxy, polyether, polyalkyl, hydroxy alkyl, and combinations thereof.

18. The method of Claim 15, wherein the aryl diazonium salt is selected from the group consisting of di-substituted aryl diazonium salts, tri-substituted aryl diazonium salts, tetra-substituted aryl diazonium salts, penta-substituted aryl diazonium salts, and combinations thereof.

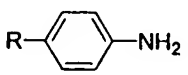
19. The method of Claim 15, wherein the diazonium species is generated *in situ* from an aniline derivative and an alkyl nitrite species.

20. The method of Claim 15, wherein the diazonium species is generated *in situ* from an aniline derivative and an inorganic nitrite in the presence of an acid.

21. The method of Claims 19 or 20, wherein the aniline derivative is selected from the group consisting of ortho-substituted anilines, meta-substituted anilines, para-substituted anilines, and combinations thereof.

22. The method of Claims 19 or 20, wherein the aniline derivative is selected from the group consisting of di-substituted anilines, tri-substituted anilines, tetra-substituted anilines, penta-substituted anilines, and combinations thereof.

23. The method of Claims 19-20 or 21, wherein the aniline derivative comprises:



and wherein R is selected from the group consisting of halogen, nitro, cyano, alkyl, aryl, arylalkyl, hydroxy, carboxylic ester, carboxylic acid, thiocarbonate, amide, alkoxy, polyether, polyalkyl, hydroxy alkyl, and combinations thereof.

24. The method of Claim 20, wherein the inorganic nitrite is sodium nitrite.

25. The method of Claims 20-23 or 24, wherein the acid is selected from the group consisting of sulfuric acid, acetic acid, hydrochloric acid, nitric acid, phosphoric acid, toluenesulphonic acid, trifluoroacetic acid, and combinations thereof.

26. A method for functionalizing carbon nanotubes comprising:

a) selecting a plurality of carbon nanotubes;

b) reacting said plurality of carbon nanotubes with an organic functionalizing agent using a dry mixing process.

27. The method of Claim 26, wherein the organic functionalizing agent is selected from the group consisting of diazonium species, aryl radicals, alkyl radicals, aryl carbocations, aryl carbanions, alkyl carbanions, alkyl carbocations, 1,3-dipoles, carbenes, heteroatom-containing radicals, heteroatom-containing cations, heteroatom-containing anions, ylides, benzyne, dienes, dienophiles, organozincates, carbenes, Grignard reagents, Gillman reagents, organolithium reagents, and combinations thereof.

28. The method of Claim 27, wherein the carbon nanotubes are functionalized between about 1 functional group per 1000 carbon atoms of the carbon nanotubes and about 1 functional group per 5 carbon atoms of the carbon nanotubes.

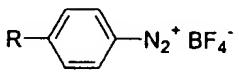
29. The method of Claim 28, wherein the carbon nanotubes are single-wall carbon nanotubes.

30. The method of Claim 29, wherein the carbon nanotubes are in the form of bucky paper.

31. The method of Claims 27-29 or 30, wherein the organic functionalizing agent is a diazonium salt.

32. The method of Claim 31, wherein the diazonium salt is selected from the group consisting of ortho-substituted aryl diazonium salts, meta-substituted aryl diazonium salts, para-substituted aryl diazonium salts, and combinations thereof.

33. The method of Claim 32, wherein the diazonium salt comprises:



and wherein R is selected from the group consisting of halogen, nitro, cyano, alkyl, aryl, arylalkyl, hydroxy, carboxylic ester, carboxylic acid, thiocarbonate, amide, alkoxy, polyether, polyalkyl, hydroxy alkyl, and combinations thereof.

34. The method of Claim 31, wherein the diazonium salt is selected from the group consisting of di-substituted aryl diazonium salts, tri-substituted aryl diazonium salts, tetra-substituted aryl diazonium salts, penta-substituted aryl diazonium salts, and combinations thereof.

35. The method of Claims 26-33 or 34, wherein the dry mixing process comprises a mechanical operation.

36. The method of Claims 26-34 or 35, wherein the dry mixing process comprises a mixing technique selected from the group consisting of ball milling, mechanical stirring, grinding, shaking, high shear mixing, twin screw mixing, and combinations thereof.

37. The method of Claims 26-35 or 36, wherein the step of reacting occurs for a duration between about 1 minute and about 1 hour.

38. The method of Claims 26-36 or 37, wherein the step of reacting occurs at a temperature between about 0°C and about 300°C.

39. The method of Claims 26-37 or 38, wherein the step of reacting occurs at a temperature between about 22°C and about 100°C.

40. The method of Claims 26-38 or 39, wherein the step of reacting is performed in an inert atmosphere.

41. The method of Claims 26-39 or 40, wherein the mixing process is carried out with an intensity between about 100 RPM and about 1500 RPM.

42. The method of Claims 35-39 or 40, wherein the materials used for the mechanical mixing processes are relatively soft.

43. The method of Claims 35-39 or 40, wherein the materials used for the mechanical mixing processes are relatively hard.

44. The method of Claims 35-39 or 40, wherein the materials used for the mechanical mixing processes have an intermediate hardness.